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Aladja Industrial Electric Drilling Machine Remotely Control Angular Speed Position Data Transfer Using Self-Synchronous Control

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ABSTRACT
Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control is presented. Self-Synchronous system is electromagnetic system device primarily used for angular position data transfer, is also known as selsyn system. It is normally used to provide a means of transmitting the position of a remotely located device to one or more indicator located far away from the transmitting area. It is like electrical machine and appears in a smaller or bigger size but depend upon when an appreciable power needed to be transferred. The windings of the rotor and stator are on the primary and secondary respectively. The three separate windings are evenly spaced 120 electrical degrees apart on the stator. A single phase transformer of primary-to-secondary coupling to be physical used for varying the relative orientation of these two windings. A transmitter is supplied with a single-phase rotor power whose output voltage depends on the position of the rotor. The output was feed to the stator windings of the second rotating receiver which is also supplies with singles-phase power follows the first motion. three stator currents changed their value immediately and the rotor shaft was turned by hand. It was turned until the current (I_1) reached its maximum value and the three stator current (I) was recorded as I_i = 1.5Aac, I_2 = 0.7Aac, I_3 = 0.7Aac. The rotor was carefully reached and turned by hand as the front face of the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was lowered. The three stator currents changed their value immediately the rotor shaft was turned by hand. It was turned until the current (I_1) reached its maximum value and the three stator current (I) were recorded as I_i = 0.7Aac, I_2 = 1.5Aac, I_3 = 0.7Aac and The rotor was carefully reached and turned by hand as the front face of the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was lowered. The three stator currents changed their value immediately the rotor shaft was turned by hand. It was turned until the current (I_1) reached its maximum value and the three stator current (I) were recorded as I_i = 0.7Aac, I_2 = 0.7Aac, I_3 = 1.5Aac. Two machines are required for Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control. One of the machines act as a receiver while the other machine act as transmitter. as the receiver makes one complete turn, the transmitter also make one complete turned. There was an appreciable torque development of the machine rotor shaft as the Aladja industrial electric drilling machine. Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was provided with an appreciable heavy wire gauge for connections of three-phase stator leads to minimize losses, then, immediately, Aladja industrial electric drilling machine transmitter and receiver started to transmit and receiving data transfer from any distance at Aladja industrial electric drilling machine at remotely control station. This is recommended for machines designers of industrial remote position controller, antenna direction indicator, wind direction indicator and gun position indicator.
Keywords Aladja industrial electric drilling machine, electromagnetic system

1.0 INTRODUCTION

Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous system is presented. Self-Synchronous system is electromagnetic system device primarily used for angular position data transfer, is also known as selsyn system. It is normally used to provide a means of

transmitting the position of a remotely located device to one or more indicator located far away from the transmitting area. It is like electrical machine and appears in a smaller or bigger size but depend upon when an appreciable power needed to be transferred. The windings of the rotor and stator are on the primary and secondary sides respectively. The three separate windings are evenly spaced 120 electrical degrees apart on the stator.[1, 6, 9] A single phase transformer of primary-to-secondary coupling to be physical used for varying the relative orientation of these two windings. A transmitter is supplied with a single-phase rotor power whose output voltage depends on the position of the rotor. The output was feed to the stator windings of the second rotating receiver which is also supplies with singles-phase power follows the first motion. The uses of shaft and other mechanical linkages are used to transmit mechanical effort over a certain distance. Transmission of mechanical power over a long distance may be militated against the transmission and in such case, remote control using Self-Synchronous system for the transmission.

The Self-Synchronous system permits the transmission and exact duplication of mechanical motion between widely separated location using wires instead of a shaft. The transmitter and receiver are the basic system connected together by wires and excited from an AC source. [1, 3, 5]

The transmitter converts mechanical motion into electrical signal. The receiver converts electrical signal into mechanical motion. The receiver and transmitter are actually wound rotor induction machine. It has three-phase stators and single-phase rotors. The stators windings are connected to each other while the rotor windings are connected to the supply source. The rotor automatically line up together in the same position when they are excited. The receiver voltages in the three phases are identical, and no current circulate in the stator. [2, 4, 12] As the rotor of the transmitter turned through a small angle, the voltages induced in the stator windings of the transmitter are no longer identical to those in the receiver. The imbalance was due to currents circulating in the stator windings. This in turn set up a magnetic field forcing the rotor of the receiver to take up the same position as the rotor of the transmitter. [7, 9, 11] The forces of considerable magnitude may be transmitted over an electric wires but depend on the size of the transmitter and the receiver. [5, 8, 10] In most cases, the Self-Synchronous system transmitter and the receiver are small because only the position information are transmitted through radar antenna and wind direction.

2.0 Laboratory Experimental Investigation of Aladja Industrial Electric Drilling Machine Remotely Control

The Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was carried out in UNIPORT standard research laboratory and the instruments, materials and component used are stated below: The power supply module, Wound rotor Induction machine, AC metering module (Voltmeter), AC metering module (Ammeter), Transmitter, Receiver Radar Antenna, position indicator for receiver and connecting leads. Using the instrument, material and components, the circuit of Aladja industrial electric drilling machine was connected as shown in figure1, "the circuit diagram of Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control for voltage measurement". The rotor was connected to terminal 7 and 8 and to the power supply terminal 4 and neutral. The rotor shaft was turned by hand, in other to be able to do so, the front face of the module have to be lower for easy turning.

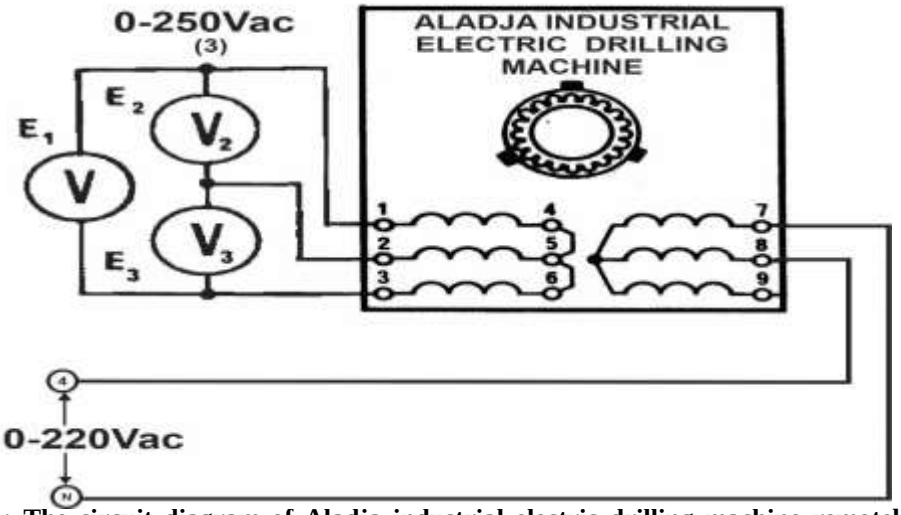

Figure 1: The circuit diagram of Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control for voltage measurement.[UNIPORT}

The power supply was turned "ON" and 50Vac was adjusted as indicated by the voltmeter. The three stator voltmeter $E_{1,}$ $E_{2,}$ and E_3 was observed. The three stator voltage changes in values as the stator were carefully turned "ON" slowly. The rotor shaft was turn "ON" until E_1 was at its maximum value. The three induced stator voltage was measured and recorded as: $E_{1,}$ = 90Vac, $E_{2,.}$ = 45Vac, E_3 = 45Vac.

The rotor shaft was turn "ON" until E_2 was at its maximum value. The three induced stator voltage was measured and recorded as: $E_{1,}$ = 45Vac, $E_{2,.}$ = 90Vac, E_3 = 45Vac. Return the rotor until E_3 the rotor shaft was turn "ON" until E_1 was at its maximum value. The three induced stator voltage was measured and recorded as: $E_{1,}$ = 90Vac, $E_{2,.}$ = 45Vac, E_3 = 45Vac.The power voltage was returned to zero and power was tuned "OFF".

Using the instrument, material and components, the circuit of Aladja industrial electric drilling machine was connected as shown in figure2, "The circuit diagram of Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control for current measurement". The current ammeter of the stator windings was connected in series with each other. The front face of the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was lowered. The power supply was turned "ON" and adjusted for 50Vac as indicated by the industrial electric drilling machine power supply voltmeter. The rotor was carefully reached and turned by hand as the front face of the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was lowered. The three stator currents changed their value immediately and the rotor shaft was turned by hand. It was turned until the current (I_1) reached its maximum value and the three stator current (I) were recorded as I_i = 1.5Aac, I_2 = 0.7Aac, I_3 = 0.7Aac. The rotor was carefully reached and turned by hand as the front face of the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was lowered. The three stator currents changed their value immediately the rotor shaft was turned by hand. It was turned until the current (I_1) reached its maximum value and the three stator current (I) were recorded as I_i = 0.7Aac, I_2 = 1.5Aac, I_3 = 0.7Aac and The rotor shaft was carefully reached and turned by hand as the front face of the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was lowered. The three stator currents changed their value immediately the rotor shaft was turned by hand. It was turned until the current (I_1) reached its maximum value and the three stator current (I) were recorded as I_i = 0.7Aac, I_2 = 0.7Aac, I_3 = 1.5Aac. The power voltage was returned to zero and power supply was tuned "OFF".

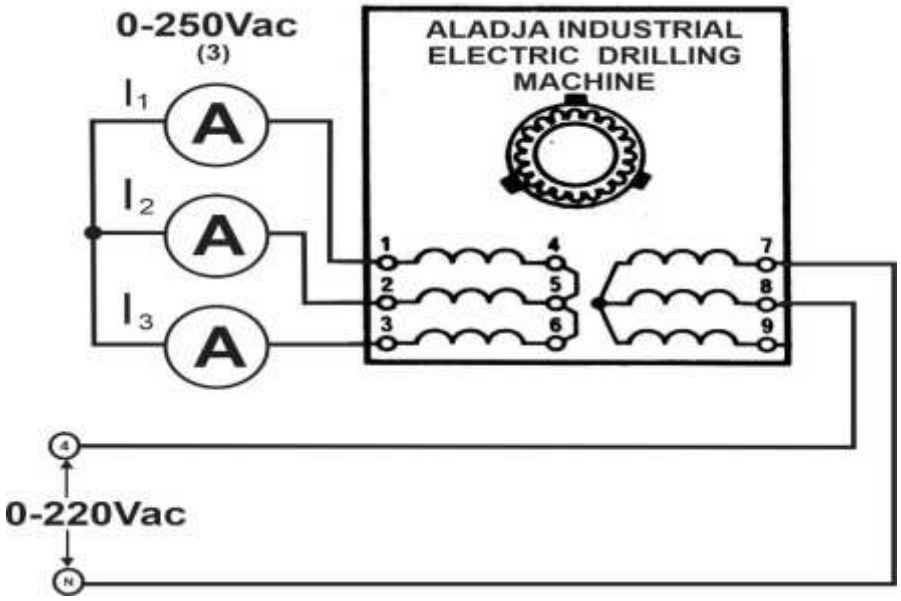

Figure2: The circuit diagram of Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control for current measurement. [UNIPORT]

Using the instrument, material and components, the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was connected as shown in figure3, "Circuit diagram of Aladja industrial electric drilling machine at remotely control station" for Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control. The stator windings of each of the Aladja industrial electric drilling machine are connected to each other. The rotor windings are parallel and connected to the variable 0-220 power supply terminal 4 and neutral (N). Two

machines are required for Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control. One of the machines act as a receiver while the other machine act as transmitter as shown in figure3. The power was turned "ON" and an adjusted was made for 100Vac as indicated on the power supply voltmeter. The rotor shaft was carefully reach and turned by hand as the front face of the Aladja industrial electric drilling machine was lowered and it was observed that the Aladja industrial electric drilling machine receiver follow in step. Thus, as the receiver makes one complete turn, the transmitter also make one complete turned. There was an appreciable torque development of the machine rotor shaft as the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was turning. When the complete turn of Aladja industrial electric drilling machine transmitter was made and the rotor shaft was broken, three stator current of Aladja industrial electric drilling machine turned momentarily and peak to maximum value and fall to zero though depend upon the rotor breaking torque.

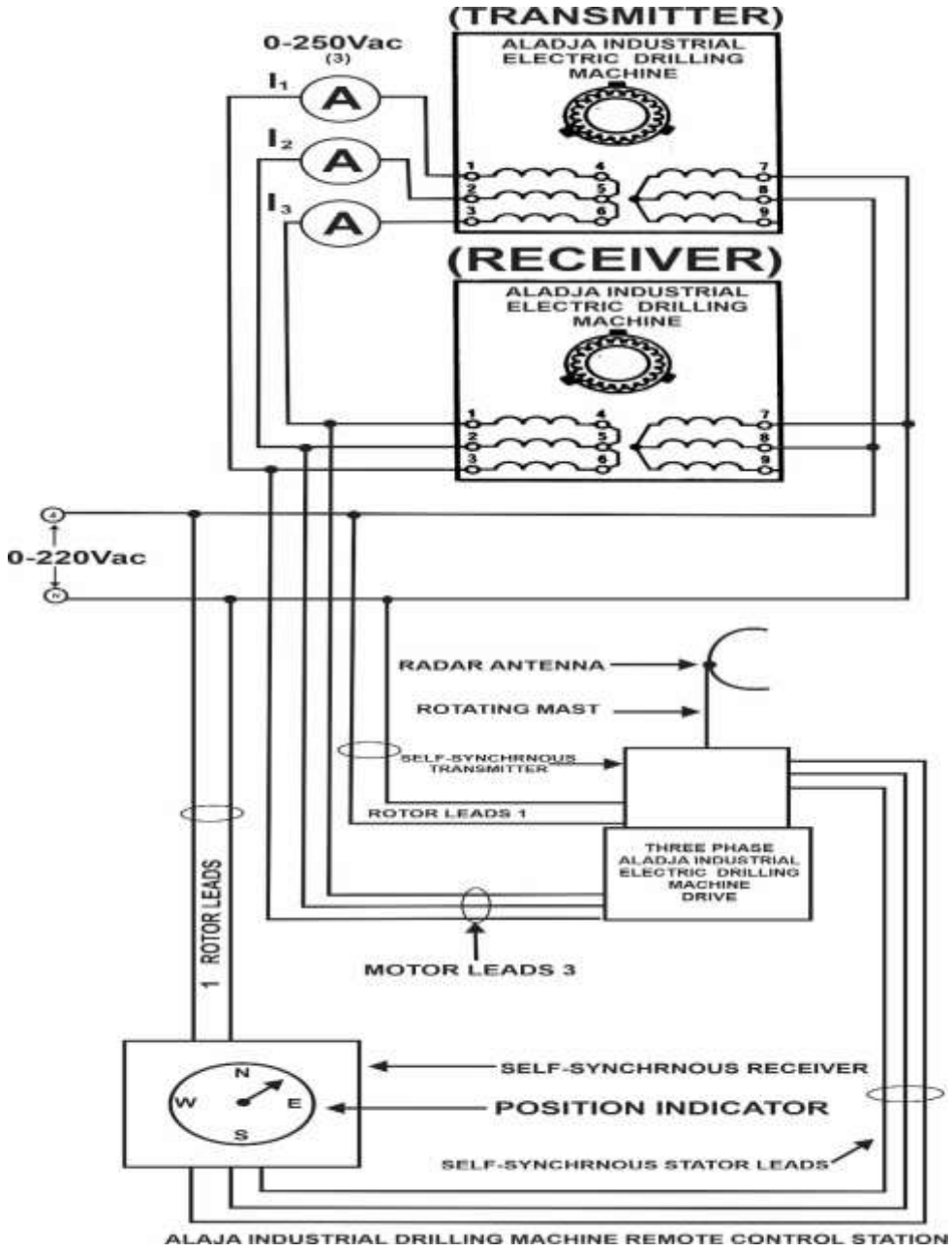

Figure3: Circuit Diagram of Aladja Industrial Electric Drilling Machine at Remotely Control Station For Aladja Industrial Electric Drilling Machine Remotely Control Angular Speed Position Data Transfer Using Self-Synchronous Control. [UNIPORT]

3.0 Equivalent D-Q Circuit Model of the Aladja Industrial Electric Drilling Machine Remotely Control

Equivalent D-Q Circuit Model of the Aladja Industrial Electric Drilling Machine Remotely Control Angular Speed Position Data Transfer Using Self-Synchronous Control [5, 6, 12]

Equivalent d-q model of Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control show in figure 4a& b is similar to the one for the synchronous machine; it has the armature resistance R, d and q axis leakage and mutual inductance ls, Lmd and Lmq [3, 7, 8]. The equivalent circuit of the motor is used for the study and simulation of motor. From the d-q modeling of the motor using the stator voltage equation the equivalent circuit motor can be derived. Assuming rotor d axis flux from the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control is represented by a constant current source as describe in the following equation $\lambda_q = L_{dm} i_f$ of figure 4.

The rotor shaft can be considered as a loop of constant current source, im located at the stator direct axis. Any change in the magnetic flux of the rotor shaft will cause an induced electromagnetic force, resulting in a circulating current. [5, 8, 12 Resistance Rm connected across the d-axis magnetization inductance Lmd show this effect. [4, 11] There is no leakage inductance in the field.

4.0 Electrical Modeling of Aladja Industrial Electric Drilling Machine Remotely Control

The d-q axis representation of Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control when the reference frames in the rotor given by [5, 6, 10]

$$v_q = r_s i_q + \frac{d\lambda_q}{dt} + \lambda_d \omega r \quad (1)$$

$$v_d = r_s i_d + \frac{d\lambda_d}{dt} - \lambda_q \omega r \quad (2)$$

$$0 = r_{kq} i_{kq} + \frac{d\lambda_{kq}}{dt} \quad (3)$$

$$0 = r_{kd} i_{kd} + \frac{d\lambda_{kd}}{dt} \quad (4)$$

Expressing equations (1- 4) in state variable form with flux linkages, we have

$$\dot{\lambda}_q = v_q - \omega_r \lambda_d + \frac{r_s}{L_{ls}}(\lambda_{mq} - \lambda_q) \quad (5)$$

$$\dot{\lambda}_d = v_d + \omega_r \lambda_q + \frac{r_s}{L_{lx}}(\lambda_{md} - \lambda_d) \quad (6)$$

$$\dot{\lambda}_{kq} = \frac{r_{kq}}{L_{lkq}}(\lambda_{mq} - \lambda_{kq}) \quad (7)$$

$$\dot{\lambda}_{kd} = \frac{r_{kd}}{L_{lkd}}(\lambda_{md} - \lambda_{kd}) \quad (8)$$

Where

$$\lambda_{mq} = L_{MQ}\left(\frac{\lambda_q}{L_{ls}} + \frac{\lambda_{kq}}{L_{lkq}}\right) \quad (9)$$

$$\lambda_{md} = L_{MD}\left(\frac{\lambda_d}{L_{ls}} + \frac{\lambda_{kd}}{L_{lkq}} + i_{fm}\right) \quad (10)$$

$$L_{MQ} = \frac{(L_{mq}L_{lkq}L_{ls})}{(L_{lkq}L_{ls} + L_{mq}L_{ls} + L_{mq}L_{lkq})} \quad (11)$$

$$L_{MD} = \frac{(L_{md}L_{lkd}L_{ls})}{(L_{lkd}L_{ls} + L_{md}L_{ls} + L_{md}L_{lkd})} \quad (12)$$

$$L_d = L_{ls} + L_{md} \quad (13)$$

$$L_q = L_{ls} + L_{mq} \quad (14)$$

$$i_q = \frac{\lambda_q - \lambda_{mq}}{L_{ls}} \quad (15)$$

$$i_d = \frac{\lambda_d - \lambda_{md}}{L_{ls}} \quad (16)$$

$$i_{kq} = \frac{\lambda_{kq} - \lambda_{mq}}{L_{lkq}} \quad (17)$$

$$i_{kd} = \frac{\lambda_{kd} - \lambda_{md}}{L_{lkd}} \quad (18)$$

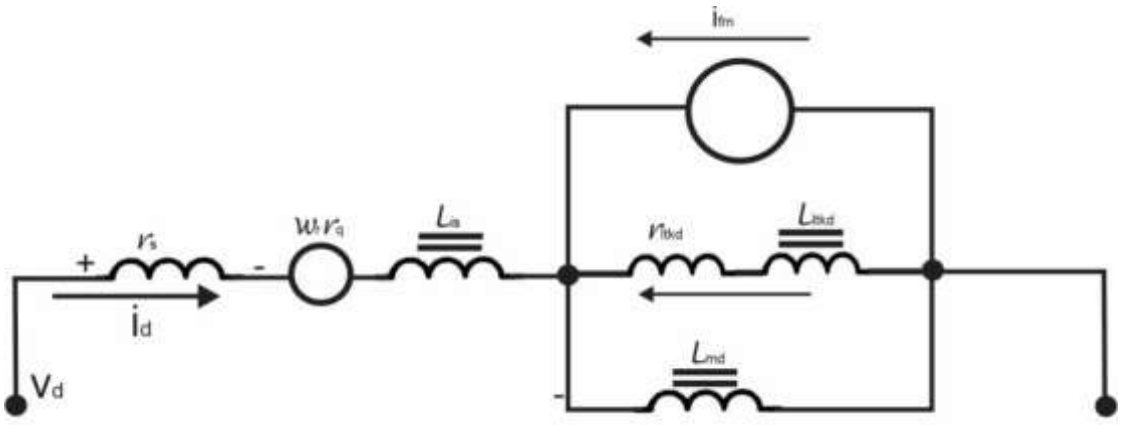

Figure4a: Equivalent circuit of Quadrature Axis of Aladja industrial electric drilling machine

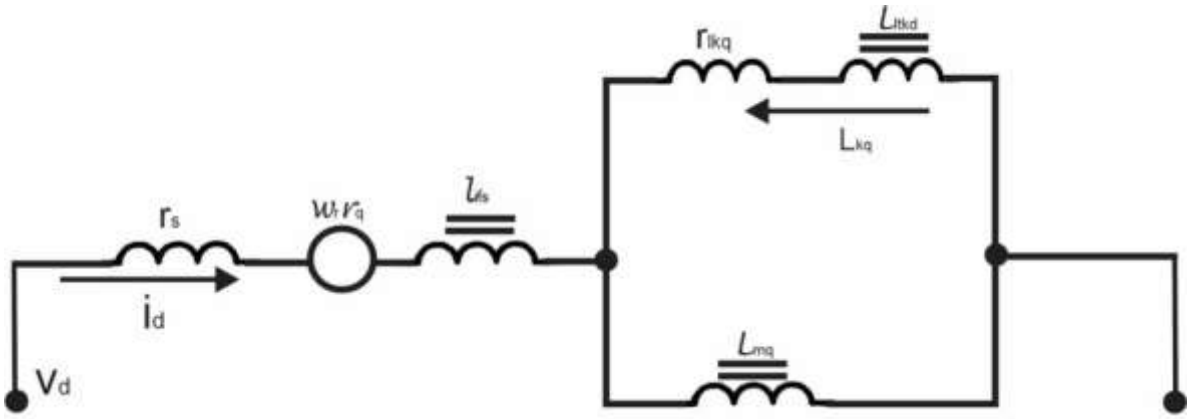

Figure4b: Equivalent circuit of Direct Axis of Aladja industrial electric drilling machine

Figure4 show Equivalent circuit of (a) Quadrature Axis (b) Direct Axis of Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control using the derived equations. Three main components of Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control torque are: Reluctance torque, Synchronous torque, Excitation torque. [2, 5, 9] Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control Machine torque

$$T_{em} = 1.5\ p\ (\lambda_d\ i_q - \lambda_q\ i_d) \quad (19)$$

Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control Reluctance Torque

$$T_r = 1.5\,P\,(L_d - L_q)i_d i_q \quad (20)$$

Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control Synchronous Torque

$$T_{syn} = 1.5\,P\,(L_{md}\,i_{kd} i_q - L_{mq}\,i_{kq} i_q) \quad (21)$$

Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control Excitation Torque [5, 6]

$$T_{ex} = 1.5\,P\,L_{md}\,i_{fm} i_q \quad (22)$$

Where P are pole pairs, assumed the line voltage are balanced,
The d-q voltages in terms of the load angle become,

$$V_d = -V \sin\delta \quad (23)$$

$$V_d = V \cos\delta \quad (24)$$

Stator phase current is related to the d-q currents [3, 9].

$$i_{ax} = i_q$$

$$i_{bx} = -\frac{1}{2} i_q - \frac{1}{\sqrt{3}} i_d \quad (25)$$

$$i_{cx} = -\frac{1}{2} i_q + \frac{1}{\sqrt{3}} i_d \quad (26)$$

5.0 Machine mechanical Model Aladja Industrial Electric Drilling Machine

Machine mechanical model of the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control which allows the inertia and mechanical load torque to be incorporated, swing equation equations (27-28),

$$\dot{\delta} = \omega_b - \omega_r \quad (27)$$

$$\dot{\omega_r} = \frac{p}{jm}(T_{em} - T_L) \quad (28)$$

Table 1: Machine Parameters of Aladja industrial electric drilling machine

Stator leakage inductance	2.59Mh
q-axis rotor leakage inductance	40.61Mh
d-axis rotor resistance	0.8113Ω
q-axis rotor resistance	1.6226Ω
q-axis magnetizing inductance	40.69Mh
d-axis magnetizing inductance	19.05mH
d-axis rotor leakage inductance	18.97Mh
Load torque	7.63Nm
Motor inertial	0.01986Kgm^2
Rated voltage	230V(208V, 255V)

Source: [2, 5]

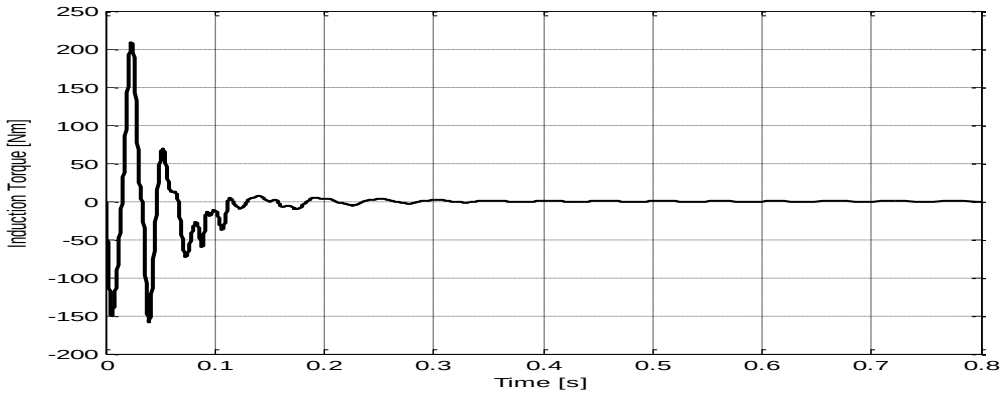

Figure 5: Graph of Aladja Industrial Electric Drilling Machine Torque against time with Self-synchronous Control at run-up Condition

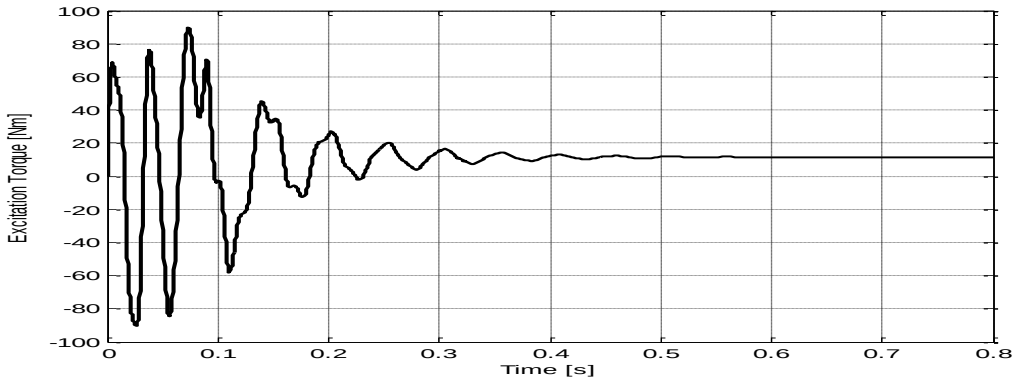

Figure 6: Graph of Aladja Industrial Electric Drilling Machine Excitation Torque against time with Self-synchronous Control at run-up Condition

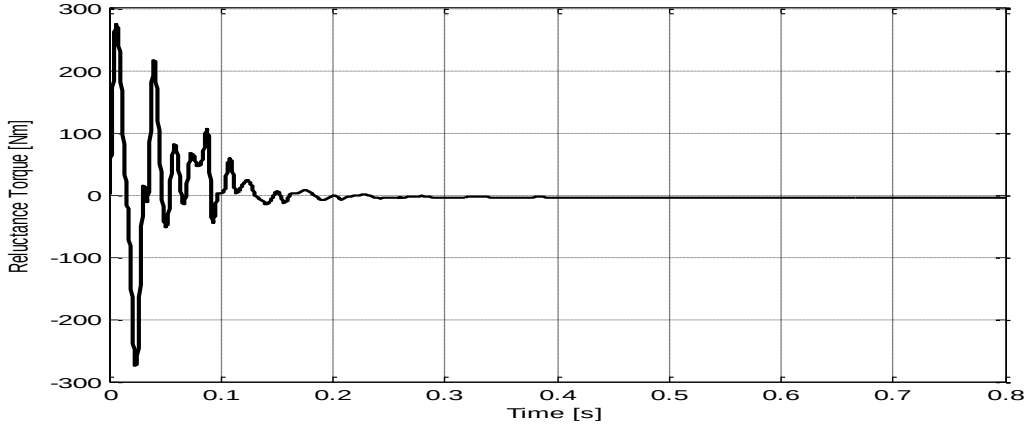

Figure 7: Graph of Aladja Industrial Electric Drilling Machine Reluctance Torque against time at run-up Condition.

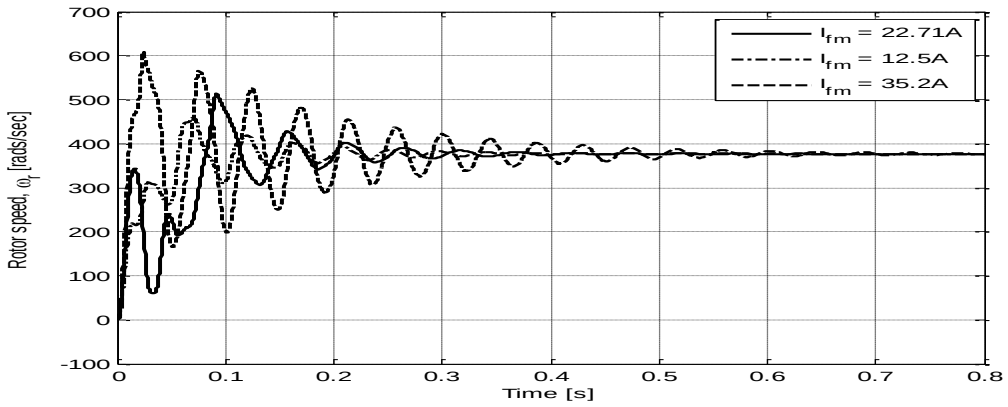

Figure 8: Graph of Aladja Industrial Electric Drilling Machine Stator Phase Currents against time with Self-synchronous Control at run-up

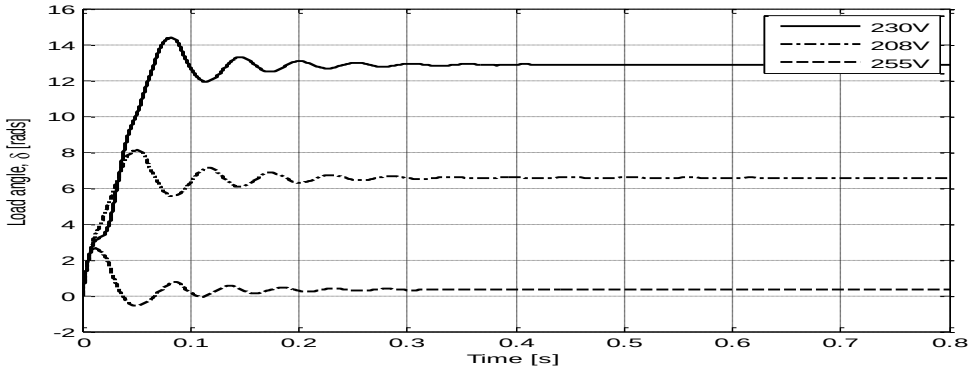

Figure 9: Graph of Aladja Industrial Electric Drilling Machine Load angle against Time with Self-synchronous for Varying Rated Voltage.

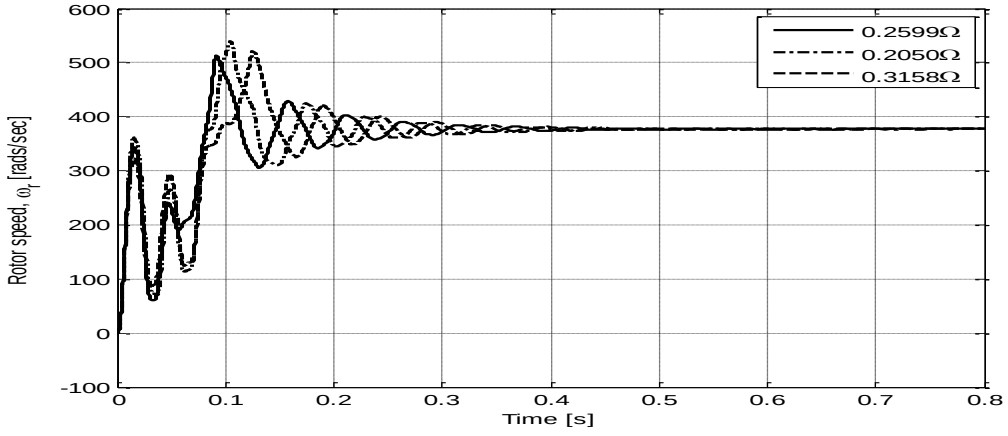

Figure 10: Graph of Aladja Industrial Electric Drilling Machine Rotor Speed against Time with Self-synchronous for Varying Stator Resistance.

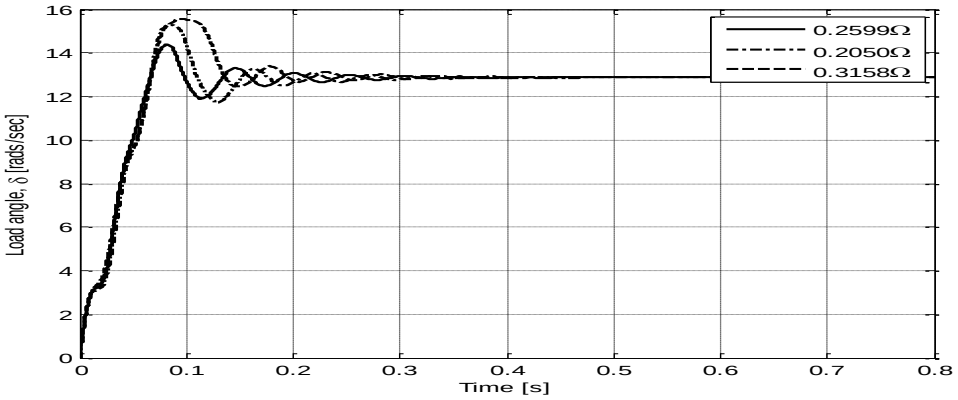

Figure 11: Graph of Aladja Industrial Electric Drilling Machine Load angle against Time with Self-synchronous for Varying Stator Resistance.

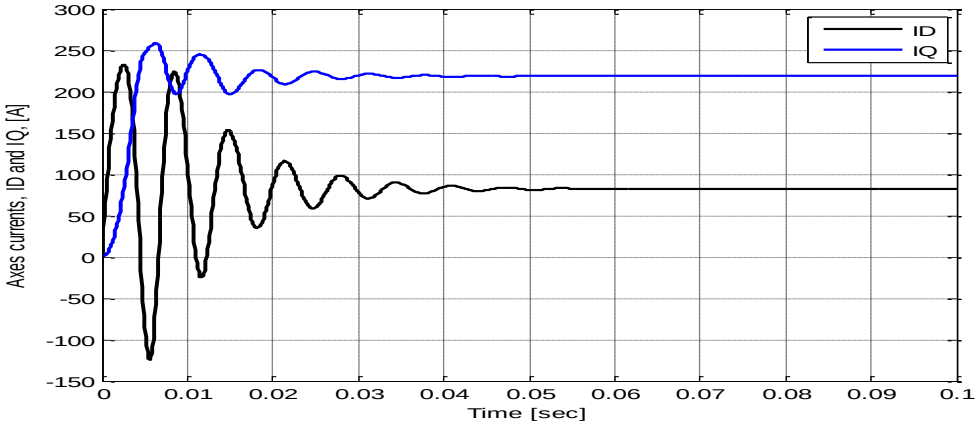

Figure 12: Graph of Aladja Industrial Electric Drilling Machine Axis Current ID and IQ against Time with Self-synchronous at run-up condition.

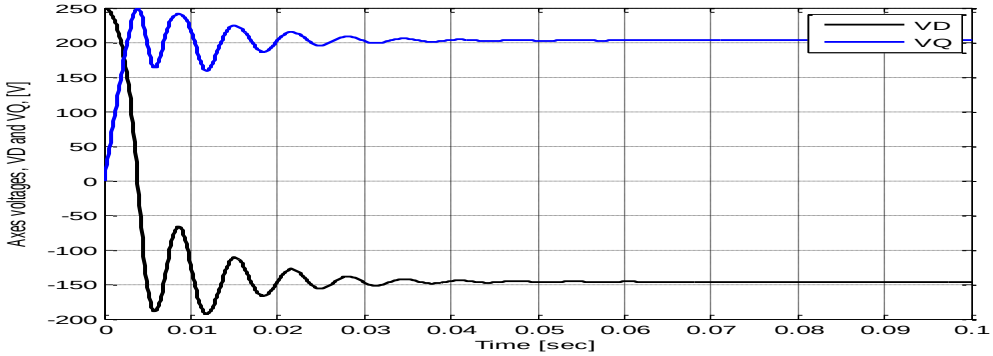

Figure 13: Graph of Aladja Industrial Electric Drilling Machine Axes Voltages VD and VQ against Time.

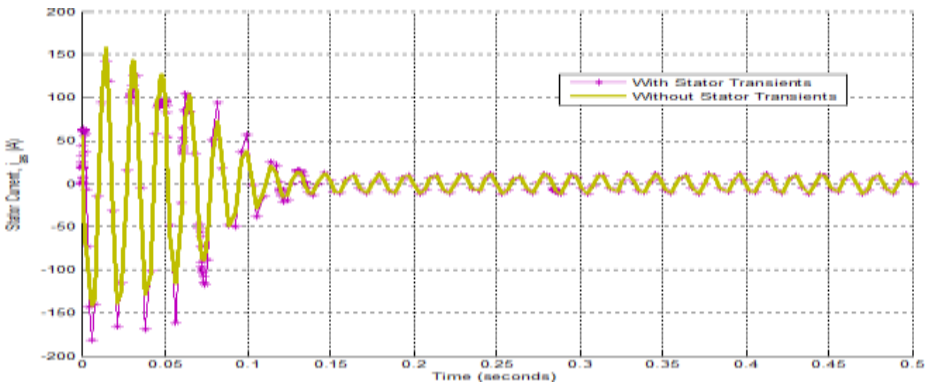

Figure-14: Graph of Aladja Industrial Electric Drilling Machine machines speed (rpm) against time (s)

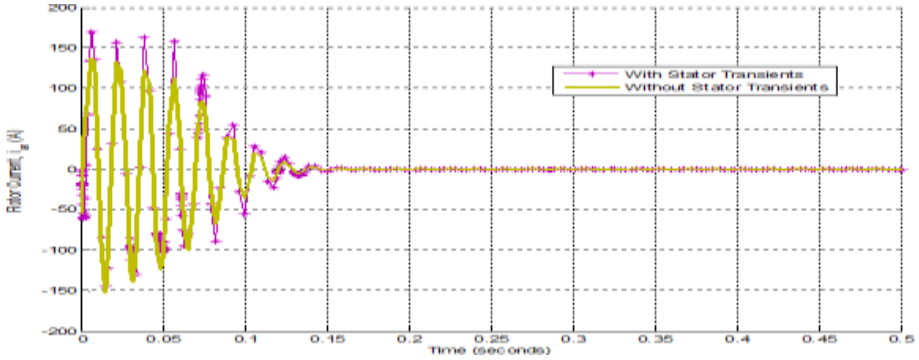

Figure15: Graph of Aladja Industrial Electric Drilling Machine stator current, as (A) against time (s)

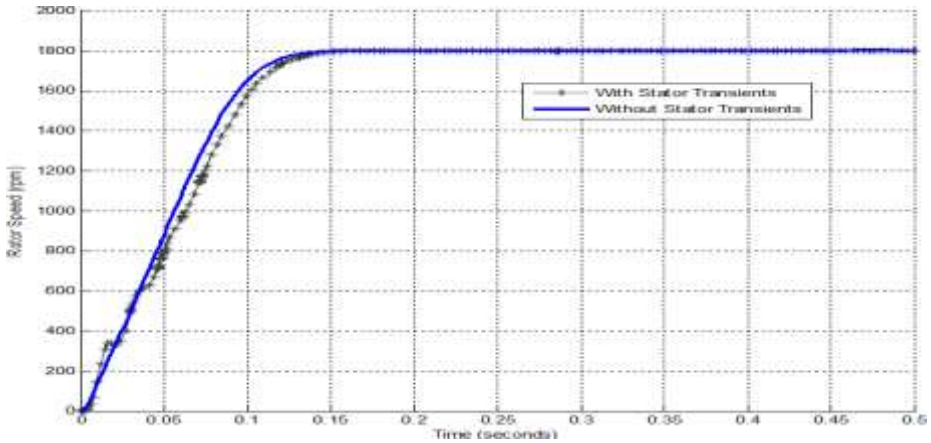

Figure 16: Graph of Aladja Industrial Electric Drilling Machine rotor current (A) against time (s)

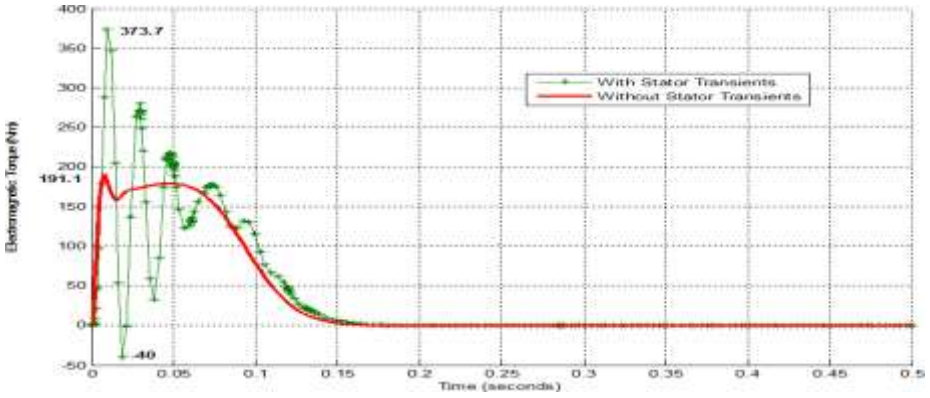

Figure 17: Graph of Aladja Industrial Electric Drilling Machine electromagnetic torque (Nm) against time (s) at start up

6.0 CONCLUSSION

The rotor was carefully reached and turned by hand as the front face of the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was lowered. The three stator currents changed their value immediately and the rotor shaft was turned by hand. It was turned until the current (I_1) reached its maximum value and the three stator current (I) was recorded as I_i = 1.5Aac, I_2 = 0.7Aac, I_3 = 0.7Aac. The rotor was carefully reached and turned by hand as the front face of the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was lowered. The three stator currents changed their value immediately the rotor shaft was turned by hand. It was turned until the current (I_1) reached its maximum value and the three stator current (I) were recorded as I_i = 0.7Aac, I_2 = 1.5Aac, I_3 = 0.7Aac and The rotor was carefully reached and turned by hand as the front face of the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was lowered. The three stator currents changed their value immediately the rotor shaft was turned by hand. It was turned until the current (I_1) reached its maximum value and the three stator current (I) were recorded as I_i = 0.7Aac, I_2 = 0.7Aac, I_3 = 1.5Aac.

Two machines are required for Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control. One of the machines act as a receiver while the other machine act as transmitter. The power was turned "ON" and an adjusted was made for 100Vac as indicated on the power supply voltmeter. The rotor shaft was carefully reach and turned by hand as the front face of the Aladja industrial electric drilling machine was lowered and it was observed that the Aladja industrial electric drilling machine receiver follow in step. Thus, as the receiver makes one complete turn, the transmitter also make one complete turned. There was an appreciable torque development of the machine rotor shaft as the Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was turning. When the complete turn of Aladja industrial electric drilling machine transmitter was made and the rotor shaft was broken, three stator current of Aladja industrial electric drilling machine turned momentarily and peak to maximum value and fall to zero though depend upon the rotor breaking torque. Aladja industrial electric drilling machine remotely control angular speed position data transfer using self-synchronous control was provided with an appreciable heavy wire gauge for connections of three-phase stator leads to minimize losses, then, immediately, Aladja industrial electric drilling machine transmitter and receiver started to transmit and receiving data transfer from any distance at Aladja industrial electric drilling machine at remotely control station. This is recommended for machines designers of industrial remote position controller, antenna direction indicator, wind direction indicator and gun position indicator.

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